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Comparative Performance of Saw and Roller Gins on Acala and Pima Cottons

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Washington, D.C. Issued June 1965

COMPARATIVE PERFORMANCE OF SAW AND ROLLER GINS ON ACALA AND PIMA COTTONS

by W. E. Chapman, Jr., and V. L. Stedronsky, Agricultural Engineering Research Division, Agricultural Research Service

INTRODUCTION

In the crop season of 1962, the Southwestern Cotton Ginning Research Laboratory, Mesilla Park, N. Mex., studied and compared the effects of roller ginning and saw ginning on the ginning performance, fiber quality, and spinning performance of Acala 1517D (*Gossypium hirsutum*) and Pima S–2 (*G. barbadense*) varieties of cotton. These are the cottons grown mainly in the El Paso trade territory.

Acala 1517D, or American upland cotton, is generally saw ginned. Its characteristically fuzzy seed has about 11 percent residual linters, and its long-staple upland fibers are 1⅛ inches long and longer. Pima S–2, or American-Egyptian cotton, is generally roller ginned. Its sparsely covered seed has about 1.5 percent residual linters, and its extra-long-staple fibers are 1⅜ inches long and longer.

PAST EXPERIMENTS IN ROLLER GINNING UPLAND AND SAW GINNING PIMA COTTONS

Early in World War II, tests and comparisons were made on the roller ginning and saw ginning of Coker Wilds, a long-staple variety of upland cotton, at Esperanza, Tex., by members of the U. S. Cotton Ginning Research Laboratory, Stoneville, Miss.[1] The roller-ginned Coker Wilds lint contained more foreign matter, graded lower, produced more manufacturing waste, and had fewer neps, than did the saw-ginned lint of this variety. Staple lengths averaged the same from both types of gins. The increase in foreign matter in lint from the roller gin accounted for a small increase in turnout.

The El Paso trade territory, consisting of New Mexico, eastern Arizona, and District 6 of Texas, is almost synonymous with the area in which Acala 1517D cotton is grown. With a few local exceptions, Pima S–2 cotton is grown in the same area and also farther west in Arizona and in California adjacent to the Arizona border. Nearly all the roller gins in the United States are located in the area in which Pima cotton is grown.

The McCarthy-type or conventional roller gin, originally developed in the Southeastern States to gin Sea Island cotton, has been used in the Southwest to gin American-Egyptian cotton with its ginning principle unchanged, including the reciprocating knife. This gin has a very low ginning capacity. Other gins used for comparison in this report are (a) the experimental flight-bar roller gin fabricated in the Southwestern Cotton Ginning Research Laboratory, and (b) an 80-saw gin. The flight-bar roller gin was developed to increase ginning capacity and reduce costs of ginning American-Egyptian cotton.

Throughout the history of cotton production in the Southwestern States, questions have been asked why American-Egyptian cotton is roller ginned and the upland cotton is saw ginned. Both of these varieties have been improved through research and, as a result, the harvesting, ginning, and marketing practices have necessarily

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[1] Gerdes, F. L., Campbell, M. E., Bennett, C. A., and Townsend, J. S. saw ginning versus roller ginning for long staple upland cotton. U.S. Dept. Agr. Food Distrib. Admin. and Agr. Res. Admin. (mimeographed), 12 pp., illus. 1943.

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also changed. Ginning research on either variety has been conducted intermittently to provide answers for existing problems.

During the period 1955–57, the Southwestern Cotton Ginning Research Laboratory, Mesilla Park, N. Mex., included conventional roller ginning with other treatments such as drying, cleaning, and saw ginning to determine the effects of various ginning treatments on fiber quality and spinning performance of Acala 1517C cotton.[2] In these tests, roller ginning, compared with saw ginning, resulted in more foreign matter (including seedcoat fragments) in the lint and consequently lower grades, more manufacturing waste, and fewer neps. In addition, classers' staple lengths were the same, but fiber lengths were shorter, and the lint contained more short fibers, according to laboratory array measurements. Calculated bale values, determined by grade, staple length, existing loan value of the cotton, and by bale weights according to laboratory measurements of foreign-matter and moisture content, were not significantly different between the two methods of ginning.

In 1959, Brown and others at the Southern Regional Research Laboratory reported their evaluation of the effects of roller ginning and saw ginning on fiber, yarn, and fabric properties and processing performance of Pima S–1 cotton ginned at the Southwestern Cotton Ginning Research Laboratory. They found that the general processing efficiency and quality of the roller-ginned Pima was better than that of the saw-ginned Pima.[3]

PURPOSE OF THIS STUDY

Each of the foregoing reports compared the effects of roller ginning and saw ginning on only one species of cotton. Changes and improvements resulting from research in the breeding, harvesting, ginning, and marketing of cotton required the comprehensive research on two species of cotton described in this report. Descriptions of these changes and improvements follow.

Acala 1517D and Pima S–2 are new varieties of cotton that have been developed very recently through research on *G. hirsutum* and *G. barbadense*, respectively. At present, spindle-type mechanical harvesters have virtually replaced hand pickers. Experimental high-capacity roller gins have been made in the laboratory and by manufacturers of gin machinery and are now in commercial use. In the ginning and marketing of cotton, there has been an increase in roller ginning of first-picked, handpicked upland cotton. This has been done to provide industry with several thousand bales of high-grade upland fiber that has relatively few neps and that can command a premium to offset the relatively high cost of ginning with the roller gins. On the other hand, several thousand bales of late, rough-harvested and ground-harvested, low-grade Pima cotton recently have been saw ginned.

Consequently, to provide up-to-date information on recent developments and practices in the ginning of cotton in the Southwest, this report describes the results of comprehensive tests among three types of cotton gins used in the ginning of two new varieties of cotton picked during three harvest periods. Differences are reported in measurements of ginning performance, cottonseed, fiber qualities, spinning performance, and spinning qualities.

EXPERIMENTAL PROCEDURE

Acala 1517D and Pima S–2 cottons were obtained in first and second harvests from the same fields, near Las Cruces, N. Mex. The three gins used in the tests were a conventional 12-inch-diameter 80-saw gin (SG), a 54-inch conventional roller gin with reciprocating knife (C), and an experimental high-capacity flight-bar roller gin (FB).

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[2] CHAPMAN, W. E., and STEDRONSKY, V. L. COTTON QUALITIES AS AFFECTED BY GINNING. (Series of four articles) The Cotton Gin and Oil Mill Press 60(11): 12; 60(12): 10; 60(14): 33; and 60(15): 25 illus., Dallas, Texas, 1959.

[3] BROWN, J. J., HOWELL, N. A., and RUPPENICKER, G. F. EFFECTS OF ROLLER GINNING AND SAW GINNING ON PIMA S–1 COTTON. Textile Res. Jour. 29: 444–449. 1959.

To maintain ginning capacity, the flight-bar roller gin allows cotton to be fed into the machine faster than it can be ginned. The overflow is reclaimed and fed back continuously to the point of ginning. The flight-bar roller gin, originally designed and set to gin Pima cotton, was used with the same settings to gin both the Pima and Acala cottons. Harvests were designated first handpicked (1st HP); first machine-picked (1st MP); and second machine-picked (2d MP). All tests were run in three replications.

To facilitate comparisons and analyses of gin performance and of the ginning effects on seed, fiber, waste, and spinning properties, the study was conducted and is reported in phases as follows:

Phase one—Consisted of ginning first handpicked 1517D Acala cotton in three gins—80 saw, flight-bar roller, and conventional McCarthy-type roller. Three replications were run. Test lots totaled 9.

Phase two—Consisted of ginning first handpicked, first machine-picked, and second machine-picked Acala 1517D cotton in flight-bar roller and 80-saw gins. Three replications were run. Test lots totaled 18.

Phase three—Consisted of ginning first machine-picked and second machine-picked Pima S–2 cotton in three gins—80 saw, flight-bar roller, and conventional McCarthy-type roller. Three replications were run. Test lots totaled 18.

Most gin-performance and ginning-effect properties of cotton measured in this study are familiar and are readily identified by their names. Those that may not be so readily identified are explained in the paragraphs that follow.

Ginning capacity is generally measured in ginning laboratories in the following way: For roller gins the capacity is measured in pounds of ginned lint per inch of roller per hour; for saw gins it is measured in pounds of ginned lint per saw per hour. In order to compare the capacity of these two types of gins in this report, the capacity of the saw gin was measured and is stated in pounds of lint per inch of saw mandrel per hour. The term pounds of lint per inch per hour (lb. lint/in./hr.) in tables 1, 2, and 3, therefore, applies to both the saw and the roller gins.

The unginned fibers measurement is expressed in grams of fibers, not linters, remaining on 100 ginned seeds. This is a new experimental measurement.

Alkali-centrifuge values are used by pathologists and cotton technologists to evaluate the effects of weathering and disease on cotton fibers.

Seedcoat fragments in ginned lint are caused by cracking seeds in the ginning process. Samples of cotton used in color measurements had been cleaned with the Shirley analyzer.[4]

Composite grades consist of classers' designations for color, leaf, and preparation. Bale weights were calculated from laboratory measurements of foreign-matter and moisture content. Prices per pound of ginned lint are based on quadrupled classification for grade and staple and on prevailing loan rates.

Staple lengths of Pima cotton less than forty-four thirty-seconds of an inch had no quoted loan value. Therefore, the price per pound of saw-ginned Pima staple was determined from existing discounts suggested by local merchants. Bale values from all cottons were calculated from bale weights and prices per pound.

Total imperfections per thousand yards of yarn included the measurements of neps, thick places, and low places in the yarn as recorded by use of the Uster instrument and can include seedcoat fragments and other foreign matter in the yarn.

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[4] Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

EXPERIMENTAL RESULTS

Phase One

In this phase first handpicked Acala 1517D cotton was ginned in three replications on an 80-saw gin, an experimental flight-bar roller gin, and a conventional roller gin. Seed cotton used for the tests averaged 8.3 percent moisture and 3.3 percent foreign matter on the trailers.

The measurements of gin performance are shown in table 1.

TABLE 1.—*Performance of 80-saw (SG), flight-bar roller (FB), and conventional roller (C) gins on first handpicked Acala 1517D cotton*

Property measured	Values from each gin—average of 3 replications, ranked from left to right [1]			Level of significance of difference [2]
Ginning capacity, lb. lint/in./hr.	FB 13.6a	SG 13.5a	C 1.8b	***
Lint turnout, pct.	FB 36.1a	SG 35.7a	C 35.6a	NS
Unginned fibers, grams/100 seeds	FB 0.144a	C 0.043b	SG 0.039b	*
Seed index, pct.	SG 13.4a	C 13.3a	FB 12.9a	NS
Total foreign matter—Shirley analyzer, pct.	C 2.29a	FB 2.18a	SG 2.18a	NS
Seedcoat fragments, do.	FB 1.1a	C 0.9ab	SG 0.5b	*
Micronaire, reading	FB 4.5a	SG 4.4ab	C 4.3b	*
Color reflectance, Rd	SG 79.6a	C 78.8ab	FB 77.8b	***
Color yellowness, plus b	FB 8.9a	SG 8.6b	C 8.6b	***
Composite grade, index	C 101.2a	FB 101.0a	SG 100.1a	NS
Classers' staple length, 32ds in.	C 36.5a	FB 36.3a	SG 36.2a	NS
Fiber neps, number/100 sq. in.	SG 8a	FB 4b	C 3b	**
Bale weight, lb.	FB 489a	SG 488a	C 488a	NS
Price per pound, dol.	C 0.3516a	FB 0.3504a	SG 0.3483b	**
Gross value per bale, do.	C 171.78a	FB 171.30a	SG 170.04a	NS
Array, upper quartile length, in.	FB 1.32a	SG 1.30b	C 1.30b	**
Array, mean length, do.	FB 1.11a	SG 1.10a	C 1.10a	NS
Array, fibers 1 inch and longer, pct.	FB 77.6a	C 75.6a	SG 74.0a	NS
Array, fibers ½ inch and shorter, do.	FB 7.0a	C 6.9a	SG 6.2a	NS
Fibrograph, upper half mean length, in.	FB 1.21a	C 1.20a	SG 1.18b	***
Fibrograph, mean length, do.	FB 1.05a	C 1.03a	SG 1.01a	NS
Pressley strength, ⅛-in. gage, grams/tex	FB 26.8a	C 26.6a	SG 26.5a	NS
Cottonseed linters, pct.	SG 10.9a	C 9.5b	FB 7.7c	***
Opening and picking waste, do.	FB 0.80a	C 0.68b	SG 0.64b	*
Card waste, do.	FB 4.87a	C 4.05b	SG 3.58c	***
Total picker and card waste, do.	FB 5.63a	C 4.70b	SG 4.19b	***
Card web, neps 100 sq. in.	FB 8a	SG 8a	C 6b	*
Yarn strength, break factor	C 2409a	SG 2394a	FB 2393a	NS
Corrected ends down number/1,000 spindle hrs.	FB 109a	C 62b	SG 60b	**
Comber noils, pct.	FB 14.3a	C 13.7a	SG 13.2a	NS
Total imperfections, number/1,000 yds.	FB 1001a	C 817a	SG 810a	NS
Yarn appearance, index	C 123a	SG 117a	FB 113a	NS

[1] Values followed by the same letter do not differ significantly, and those followed by unlike letters differ significantly at the probability level shown in column 5, according to Duncan's Multiple Range test.

[2] The level of confidence in repeatability of results is indicated by asterisks as follows: *** at the 99-percent level; ** at the 95-percent level; and * at the 90-percent level. NS means not significant.

Cotton Property Relationships

Relationships between fiber, cottonseed, and spinning properties were studied to determine the cause of differences in spinning performance of the cottons passed through the three types of gins. These relationships are:

Seedcoat fragments in ginned lint and cottonseed linters.—The flight-bar gin produced seed with least linters and lint that contained the most seedcoat fragments. By contrast, the saw gin left the most linters on the seed and produced lint with the fewest seedcoat fragments. It was apparent that the treatment, which "ginned close to the seed" or left fewest linters on the seed, also cracked or chipped more seeds, and this caused more seedcoat fragments in the ginned lint. No lint cleaning was used. A lint cleaner would have removed some of the seedcoat fragments.

Short fibers and cottonseed linters.—The flight-bar gin, which reduced the percentage of cottonseed linters, also slightly increased the percentage of short fibers in the ginned lint. By contrast, the saw gin, which left the most linters on the seed, produced slightly fewer short fibers in the ginned lint. The increased percentage of short fibers in ginned lint may have included linters removed from the seed. Another possibility is that the harsh treatment that removed excessive linters from the seed also broke fibers.

Ends down and cottonseed linters.—The correlation between these measurements indicated that the ginning treatment (FB) that was harsh enough to remove excessive linters from the seeds also increased seedcoat fragments in the ginned lint and slightly increased the short fibers in the lint. It appeared that "ginning too close to the seed" had a cumulative effect of increasing both seedcoat fragments and short fibers, and that these increased ends down and total imperfections in yarn. Apparently, neither yarn strength nor yarn appearance were affected.

Summary of Phase One

Ginning capacity was approximately the same for the flight-bar roller gin and the saw gin, but that of the conventional roller gin was considerably less than either of these. Seedcoat fragments were highest in lint ginned by the flight-bar roller gin. Previous tests have shown that roller gins usually cause more seedcoat fragments in ginned lint than do the saw gins.[5]

Micronaire readings of cotton from the flight-bar roller gin were slightly higher than those from the other gins, although the range was narrow. Past experiments have shown that additional foreign matter in samples can cause higher Micronaire readings.

The greater yellowness of lint from the flight-bar roller gin might indicate that this gin operated with higher frictional temperature than the other two types of gins.

Comparison of the saw gin and the conventional roller gin shows that lint from the latter had fewer neps in ginned fibers and slightly fewer in the card web. Counts of neps in lint from all gins were considered low and satisfactory in the trade. As a rule, the fiber and spinning qualities of cotton from the saw and conventional roller gins were similar.

Prices per pound were nearly the same for cotton from all three types of gins. The similarity resulted from the accumulated nonsignificant differences in grade and staple.

Corrected ends down per thousand spindle hours were significantly greater in lint ginned by the flight-bar roller gin. This gin, originally developed for use with American-Egyptian cotton, was used for ginning upland cotton at the same speed and pressure that are generally used for American-Egyptian cotton.

The performance of the flight-bar roller gin compared with that of the other two gins shows that the former did not adequately preserve the qualities of Acala 1517D cotton. When ginning Acala cotton, the flight-bar gin removed excessive linters from the seed, cracked the seed, and increased seedcoat fragments in the ginned lint. All of these effects of ginning apparently contributed to increased waste and ends down in spinning. Additional research is being conducted to determine how to modify the flight-bar design to allow it to gin upland cotton satisfactorily.

Measured properties that were not significantly different in cotton produced by the three types of gins were: Turnout, nonlint content, grade, staple, bale weight, bale value, array and Fibrograph mean lengths, short fibers, fiber strength, yarn strength, comber noils, total imperfections in yarn, and yarn appearance.

Phase Two

In this phase, first handpicked, first machine-picked, and second machine-picked Acala 1517D cotton was ginned in three replications in a saw gin and an experimental flight-bar roller gin. The conventional McCarthy-type roller gin was not used.

On arrival at the laboratory, wagon samples of the first handpicked cotton contained 3.6 percent foreign matter; the first machine-picked, 3.8 percent; and the second machine-picked, 8.2 percent. These cottons contained 8.2, 9.9, and 8 percent moisture, respectively. The second machine-picked cotton contained the most trash but had the least moisture. Ginned cotton was processed through a tower drier at 175° F., a 6-cylinder cleaner, a bur machine, a 6-cylinder cleaner, and an extractor-feeder. A lint cleaner was not used.

Measurements of gin performance are shown in table 2.

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[5] See footnote 2, page 2.

TABLE 2.—*Performance of 80-saw and flight-bar roller gins on first handpicked (1st HP), first machine-picked (1st MP), and second machine-picked (2d MP) Acala 1517D cotton*

Properties measured	Harvests	Values for—[1]		Difference based on flight-bar gin	Significance between gins [2]
		Saw gin	Flight-bar gin		
Capacity lb. lint/in./hr	1st HP 1st MP 2d MP	13. 5a 15. 6a 12. 3a	13. 6a 11. 6a 9. 4a	−0. 1 4. 0 2. 9	NS *** ***
Average		13. 8	11. 5	2. 3	***
Significance between harvests [2]		NS	NS		
Lint turnout pct	1st HP 1st MP 2d MP	35. 7a 34. 6a 35. 2a	36. 1a 35. 4a 35. 9a	−. 4 −. 8 −. 7	NS NS NS
Average		35. 2	35. 8	−. 6	*
Significance between harvests [2]		NS	NS		
Unginned fibers grams/100 seeds	1st HP 1st MP 2d MP	. 039a . 022 b . 009 b	. 144a . 090 b . 068 c	−. 105 −. 068 −. 059	*** ** *
Average		. 023	. 101	−. 078	***
Significance between harvests [2]		***	***		
Seed index grams/100 seeds	1st HP 1st MP 2d MP	13. 4a 13. 0a 10. 2 b	12. 9a 12. 6a 10. 1 b	. 5 . 4 . 1	NS NS NS
Average		12. 2	11. 9	. 3	NS
Significance between harvests [2]		**	**		
Cottonseed linters pct	1st HP 1st MP 2d MP	10. 9a 11. 4a 11. 0a	7. 7 b 8. 5a 8. 4a	3. 2 2. 9 2. 6	*** *** ***
Average		11. 1	8. 2	2. 9	***
Significance between harvests [2]		NS	*		
Seedcoat fragments pct	1st HP 1st MP 2d MP	. 5 b . 7ab 1. 7a	1. 1a 1. 5a 1. 7a	−. 6 −. 8	*** *** NS
Average		1. 0	1. 4	−. 4	***
Significance between harvests [2]		*	NS		
Micronaire reading	1st HP 1st MP 2d MP	4. 4a 3. 8a 2. 9 b	4. 5a 4. 0a 3. 1 b	−. 1 −. 2 −. 2	NS ** **
Average		3. 7	3. 9	−. 2	***
Significance between harvests [2]		***	***		
Alkali-centrifuge value	1st HP 1st MP 2d MP	175 b 181 b 204a	174 b 182ab 203a	1 −1 1	NS NS NS
Average		187	186	1	NS
Significance between harvests [2]		**	**		
Fiber neps number/100 sq. in.	1st HP 1st MP 2d MP	8 b 16a 16a	4 b 8a 10a	4 8 6	** *** ***
Average		13	7	6	***
Significance between harvests [2]		***	**		

See footnotes at end of table.

TABLE 2.—*Performance of 80-saw and flight-bar roller gins on first handpicked (1st HP), first machine-picked (1st MP), and second machine-picked (2d MP) Acala 1517D cotton*—Continued

Properties measured	Harvests	Values for—[1]		Difference based on flight-bar gin	Significance between gins [2]
		Saw gin	Flight-bar gin		
Pressley strength, ⅛-in. gage grams/tex	1st HP	26. 5ab	26. 8a	−0. 3	NS
	1st MP	27. 2a	26. 9a	. 3	NS
	2d MP	26. 2 b	25. 8 b	. 4	NS
Average		26. 6	26. 5	. 1	NS
Significance between harvests [2]		**	**		
Array, upper quartile length in	1st HP	1. 30a	1. 32a	−. 02	*
	1st MP	1. 31a	1. 31a		NS
	2d MP	1. 31a	1. 30a	. 01	NS
Average		1. 31	1. 31		NS
Significance between harvests [2]		NS	NS		
Array, mean length in	1st HP	1. 10ab	1. 11a	−. 01	NS
	1st MP	1. 11a	1. 10a	. 01	NS
	2d MP	1. 07 b	1. 05 b	. 02	NS
Average		1. 09	1. 09		NS
Significance between harvests [2]		*	*		
Array, fibers 1 in. and longer pct	1st HP	74. 0a	77. 6a	−3. 6	**
	1st MP	75. 0a	75. 8a	−. 8	NS
	2d MP	69. 6 b	68. 7 b	−. 9	NS
Average		72. 9	74. 0	−1. 1	NS
Significance between harvests [2]		*	**		
Array, fibers ½ in. and shorter pct	1st HP	6. 2 b	7. 0 b	−. 8	NS
	1st MP	6. 2 b	7. 9 b	−1. 7	**
	2d MP	8. 6a	11. 0a	−2. 4	**
Average		7. 0	8. 9	−1. 9	***
Significance between harvests [2]		***	***		
Fibrograph, upper half mean length in	1st HP	1. 18a	1. 21a	−. 03	**
	1st MP	1. 20a	1. 20a		NS
	2d MP	1. 19a	1. 19a		NS
Average		1. 19	1. 20	−. 01	*
Significance between harvests [2]		NS	NS		
Fibrograph, mean length in	1st HP	1. 01a	1. 05a	−. 04	**
	1st MP	1. 02a	1. 03a	−. 01	NS
	2d MP	. 95 b	. 96 b	−. 01	NS
Average		. 99	1. 01	−. 02	*
Significance between harvests [2]		**	**		
Color, reflectance Rd pct	1st HP	79. 6a	77. 8a	1. 8	**
	1st MP	77. 4 b	75. 6 b	1. 8	**
	2d MP	78. 7ab	78. 1a	. 6	NS
Average		78. 6	77. 2	1. 4	***
Significance between harvests [2]		**	**		
Color, yellowness plus b	1st HP	8. 6a	8. 9a	−. 3	**
	1st MP	8. 7a	8. 9a	−. 2	*
	2d MP	8. 1 b	8. 6a	−. 5	***
Average		8. 5	8. 8	−. 3	***
Significance between harvests [2]		**	NS		

See footnotes at end of table.

TABLE 2.—*Performance of 80-saw and flight-bar roller gins on first handpicked (1st HP), first machine-picked (1st MP), and second machine-picked (2d MP) Acala 1517D cotton*—Continued

Properties measured	Harvests	Values for—[1]		Difference based on flight-bar gin	Significance between gins [2]
		Saw gin	Flight-bar gin		
Nonlint content–Shirley analyzer pct	1st HP	2. 18 c	2. 18 b	0	NS
	1st MP	3. 89 b	3. 66 b	0. 23	NS
	2d MP	6. 64a	6. 59a	. 05	NS
Average		4. 24	4. 14	. 10	NS
Significance between harvests [2]		**	**		
Lint moisture pct	1st HP	4. 23 b	4. 35a	—. 12	NS
	1st MP	5. 43ab	5. 22a	—. 21	NS
	2d MP	5. 95a	5. 03a	—. 92	**
Average		5. 20	4. 87	. 33	*
Significance between harvests [2]		*	NS		
Calculated bale weights lb	1st HP	488 b	489 b	—1	NS
	1st MP	502 b	501ab	1	NS
	2d MP	521 a	516a	5	**
Average		504	502	2	**
Significance between harvests [2]		***	***		
Composite grade index	1st HP	100. 1a	101. 0a	—. 9	NS
	1st MP	90. 9 b	92. 2 b	—1. 3	*
	2d MP	90. 7 b	90. 1 b	. 6	NS
Average		93. 9	94. 6	—. 7	*
Significance between harvests [2]		***	***		
Staple length 32ds in	1st HP	36. 2a	36. 3a	—. 1	NS
	1st MP	36. 4a	36. 3a	. 1	NS
	2d MP	36. 2a	36. 1a	. 1	NS
Average		36. 3	36. 2	. 1	NS
Significance between harvests [2]		NS	NS		
Price per pound dol	1st HP	. 3483a	. 3504a	—. 0021	NS
	1st MP	. 3168 b	. 3216 b	—. 0048	NS
	2d MP	. 3134 b	. 3135 b	—. 0001	NS
Average		. 3261	. 3285	—. 0025	NS
Significance between harvests [2]		***	***		
Bale value dol	1st HP	170. 04a	171. 30a	—1. 26	NS
	1st MP	159. 38 b	161. 09 b	—1. 71	NS
	2d MP	163. 38 b	161. 74 b	1. 64	NS
Average		164. 27	164. 71	—. 44	NS
Significance between harvests [2]		***	***		
Opening and picking waste pct	1st HP	. 64 b	. 80 b	—. 16	NS
	1st MP	1. 07 b	1. 23 b	—. 16	NS
	2d MP	1. 94a	2. 26a	—. 32	**
Average		1. 22	1. 43	—. 21	***
Significance between harvests [2]		**	**		
Card waste pct	1st HP	3. 58 b	4. 87 c	—1. 29	***
	1st MP	4. 55 b	5. 88 b	—1. 33	***
	2d MP	6. 91a	7. 40a	—. 49	**
Average		5. 01	6. 05	—1. 04	***
Significance between harvests [2]		**	**		

See footnotes at end of table.

TABLE 2.—*Performance of 80-saw and flight-bar roller gins on first handpicked (1st HP), first machine-picked (1st MP), and second machine-picked (2d MP) Acala 1517D cotton*—Continued

Properties measured	Harvests	Values for—[1]		Difference based on flight-bar gin	Significance between gins [2]
		Saw gin	Flight-bar gin		
Total picker and card waste, pct.	1st HP	4.19 c	5.63 c	−1.44	***
	1st MP	5.57 b	7.04 b	−1.47	***
	2d MP	8.72a	9.49a	−.77	**
Average		6.16	7.38	−1.22	***
Significance between harvests [2]		***	***		
Comber noils, pct.	1st HP	13.2 b	14.3 b	−1.1	NS
	1st MP	13.4ab	15.2a	−1.8	**
	2d MP	13.9a	15.8a	−1.9	**
Average		13.5	15.1	−1.6	***
Significance between harvests [2]		**	**		
Yarn strength, break factor	1st HP	2394 b	2393a	1	NS
	1st MP	2564a	2427a	137	**
	2d MP	2555a	2444a	111	*
Average		2504	2421	83	**
Significance between harvests [2]		*	NS		
Card web, neps/100 sq. in.	1st HP	8 b	8 b		NS
	1st MP	12 b	13 b	−1	NS
	2d MP	32a	28a	4	*
Average		18	17	1	NS
Significance between harvests [2]		***	***		
Total imperfections, number/1,000 yd.	1st HP	810 b	1001 b	−191	NS
	1st MP	991ab	1347 b	−356	*
	2d MP	1532a	2034a	−502	**
Average		1111	1461	−350	**
Significance between harvests [2]		**	**		
Corrected ends down, number/1,000 spindle hr.	1st HP	60 b	109 b	−49	**
	1st MP	58 b	94 b	−36	*
	2d MP	129a	169a	−40	**
Average		83	124	−41	***
Significance between harvests [2]		*	*		
Yarn appearance, index	1st HP	117a	113a	4	*
	1st MP	110ab	110ab	0	NS
	2d MP	97 b	100 b	−3	NS
Average		108	108	0	NS
Significance between harvests [2]		***	**		

[1] Values followed by the same letter or letters do not differ significantly, and those followed by an unlike letter or letters differ significantly at the probability level shown by asterisks, according to Duncan's Multiple Range test.

[2] The probability level, or confidence in repeatability of results, is indicated by asterisks as follows: *** at the 99 percent level; ** at the 95 percent level; and * at the 90 percent level. NS means not significant.

Cotton Property Relationships

The causes for some of the differences in spinning performance between the flight-bar roller and saw gins might be better understood by studying the relationships between some of the measurements on cottonseed, fiber, and spinning performance. The flight-bar gin left fewer linters and more unginned fibers on the seed, cracked more seed, and caused more seedcoat fragments in the ginned lint than did the saw gin. Removing linters from the seed presumably accounted for some of the slight increase in short fibers in the ginned lint. The increase in seedcoat fragments and the increase in short fibers or both, contributed to the increase in total imperfections in the yarn and to ends down in spinning.

The slight increase in Micronaire of lint produced by the flight-bar roller gin could have been caused by the slight increases in linters and other foreign matter in the ginned lint.

The increased measurable yellowness of lint from the flight-bar roller gin did not lower the classers' grade. Previous research indicated that yellowness of the ginned lint can be increased with high seed-cotton drying moistures. Therefore, the increased yellowness in lint from the flight-bar roller gin might have been caused by high frictional temperature inherent in this method of ginning. All samples tested with the colorimeter had been cleaned with the Shirley analyzer; consequently, the color measurements were not affected by trash.

Alkali-centrifuge values showed no differences between gins but were significantly higher for the second-picked cotton than for the first-picked. Not shown is the high negative correlation for alkali-centrifuge values and Micronaire readings (−0.86). The alkali-centrifuge values showed that primary wall damage caused by one type of gin was no greater than that caused by the other type of gin.

The relationship between mean length and upper half mean length indicates that fibers of the second-picked cotton were less uniform in length than those of first-picked cotton.

Summary of Phase Two

Considering cotton from the three harvests collectively, there were no significant differences in fiber strength, laboratory and classers' staple length, nonlint content, price per pound, bale values (premiums on roller-ginned upland cotton were not considered), card web neps, and yarn appearance.

The saw gin had greater capacity, but its turnout was a fraction of a percentage point lower than that of the flight-bar roller gin. In addition, the saw gin removed fewer linters from the seed. Lint from this gin contained fewer seedcoat fragments and short fibers and had more neps and less manufacturing waste than that produced by the flight-bar roller gin. Yarn made from this lint was stronger and had fewer ends down than that made from lint produced by the flight-bar gin.

Most fiber properties were similar for lint produced by the two gins including even the nonlint content. The flight-bar roller gin, which was designed and set to gin Pima cotton, apparently had a harsh action that cracked the seed of the upland cotton and removed excessive linters from seeds. This action caused the ginned lint to have relatively more seedcoat fragments and short fibers than that produced by the saw gin. Extraneous materials that originated from the seed obviously caused more waste and more ends down when spinning upland cotton that had been ginned by the flight-bar roller gin than that ginned by the saw gin.

The slight differences in composite grade are interpreted to mean only that the grades of lint from the flight-bar roller gin were as good as those from the saw gin. The grade of the first hand-picked cotton from each gin was significantly better than for the two machine-picked cottons.

The flight-bar roller gin was developed to gin American-Egyptian cotton. When used in this test to gin upland cotton, the flight-bar gin was operated at the same pressure and speed as when it was ginning American-Egyptian cotton. Subsequent research indicates that to maintain lint quality, the flight-bar roller gin should be set differently to gin upland cotton than to gin American-Egyptian cotton. Additional research is needed, however, to determine the proper gin settings that will preserve fiber and spinning qualities of upland cotton.

Phase Three

In this phase, first machine-picked and second machine-picked Pima S–2 cottons were ginned in three replications in an experimental flight-bar roller gin, a conventional McCarthy-type roller gin, and a conventional 12-inch-diameter 80-saw gin. Tests were designed to compare the effects of the three gins on cotton from each of the two harvests. Gin performance and the ginning effects on cottonseed and fiber qualities, bale values, spinning performance, and other cotton properties were measured.

The saw gin was included in this phase to provide information on the possibility of saw ginning the new extra-long-staple variety Pima S–2 cotton. In 1959 Brown and others [6] compared the roller ginning and saw ginning of Pima S–1 cotton and stated that the roller-ginned cotton could be processed more efficiently than saw-ginned cotton. In addition, the yarn and fabric made from roller-ginned cotton had better quality and appearance than that made from saw-ginned cotton.[6] Late rough-harvested and ground-harvested Pima cottons have been saw-ginned commercially very recently in the El Paso area.

Wagon samples of the first machine-picked Pima S–2 cotton used in phase three contained 5.2 percent foreign matter; the second machine-picked, 7.3 percent. The moisture content of these samples was 9.6 and 7.5 percent, respectively.

Drying and cleaning setups were kept constant in each of the two harvest seasons. The first machine-picked cotton was processed through a tower drier at 175° F., a 6-cylinder cleaner, a bur machine, a 6-cylinder cleaner, and an extractor-feeder. A lint cleaner was not used. The second machine-picked cotton was processed through a tower drier without heat, a 6-cylinder cleaner, a bur machine, a 6-cylinder cleaner, a 7-cylinder cleaner, and an extractor-feeder. A lint cleaner was not used. Experimental results are shown in table 3.

Ginning capacity (table 3) of the flight-bar roller gin (FB) compared favorably with that of the saw gin (SG) and was several times better than that of the conventional roller gin (C). There was no significant difference in lint turnout among the three gins. Turnout was greater for the second harvest than for the first. Differences in turnout were probably caused by the cumulative effects of significantly lighter weight seed in the second harvest and slightly heavier bale weights resulting from slightly higher trash and lint moisture contents.

Seed index values were smaller from the second-harvested cotton than from the first-harvested for each ginning treatment. This probably accounts for some of the greater lint turnout for the second harvest than for the first.

Alkali-centrifuge values were greater for second-harvested cotton than for first-harvested and were not affected by ginning treatment. Not shown in table 3 is the negative correlation (−0.68) between Micronaire readings and alkali-centrifuge; the significance is at a high level of confidence. The similarity in alkali-centrifuge values among gins shows that the primary wall of the fibers was not affected any more by one type of gin than by another type.

The flight-bar roller gin compared favorably with the conventional roller gin and was superior to the saw gin in the separation of fibers from seeds, according to measurements of unginned fibers remaining on the seed, residual linters on the seed, and seedcoat fragments in the ginned lint.

The flight-bar roller gin compared favorably with the conventional roller gin and was superior to the saw gin in preserving fiber qualities such as tensile strength, fiber length and length distribution, and lint color (reflectance and yellowness). The flight-bar roller gin compared favorably with the conventional roller gin and was superior to the saw gin in holding the trash content to a low level, in fiber neps, and in short fibers in the ginned lint.

The flight-bar roller gin compared favorably with both other gins in classers' grades and was superior to the saw gin in classers' staple length, price per pound of lint, and in calculated bale values. Mean lengths indicate a slight shortening of Pima fibers that had passed through the saw gin. Average staple lengths for the saw-ginned Pima at each harvest were 43.3 thirty-seconds of an inch. This is important because lengths less than forty-four thirty-seconds of an inch are not eligible for Government loan and are very difficult to sell. Shorter staple lengths produced by the saw gin resulted in lower prices per pound and lower bale values.

The flight-bar roller gin compared favorably or was superior to the conventional roller gin and the saw gin in nearly all measurements of manufacturing waste, card web neps, ends down, and in yarn strengths, appearance, and total imperfections.

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[6] See footnote 3, page 2.

TABLE 3.—*Performance of 80-saw (SG), flight-bar roller (FB), and conventional roller (C) gins on first machine-picked and second machine-picked Pima S–2 cotton*

Property measured	Type of gin	Harvests [1]		Difference based on 1st-picked cotton	Significance between harvests [2]
		1st machine picked	2d machine picked		
Capacity lb. lint/in./hr	SG	13. 9 b	18. 0a	−4. 1	*
	FB	20. 4a	14. 5 b	5. 9	**
	C	3. 0 c	2. 6 c	. 4	NS
Significance between gins [2]		***	***		
Lint turnout pct	SG	34. 8a	37. 2a	−2. 4	**
	FB	34. 6a	36. 0a	−1. 4	*
	C	33. 5a	36. 7a	−3. 2	***
Significance between gins [2]		NS	NS		
Unginned fibers grams/100 seeds	SG	. 029a	. 053a	−. 024	NS
	FB	. 034a	. 014 b	−. 020	NS
	C	. 011a	. 002 b	−. 009	NS
Significance between gins [2]		NS	**		
Seed index grams/100 seeds	SG	12. 49a	10. 87a	1. 80	***
	FB	12. 52a	10. 69a	1. 83	***
	C	11. 94 b	10. 92a	1. 02	**
Significance between gins [2]		*	NS		
Cottonseed linters pct	SG	1. 8a	2. 2a	−. 4	NS
	FB	1. 3 b	1. 3 b	0	NS
	C	1. 4 b	1. 7ab	−. 3	NS
Significance between gins [2]		**	***		
Seedcoat fragments pct	SG	. 5a	. 9a	−. 4	NS
	FB	. 7a	. 4 b	. 3	NS
	C	. 6a	. 6ab	0	NS
Significance between gins [2]		NS	**		
Micronaire reading	SG	4. 0 b	3. 4a	. 6	*
	FB	4. 2a	3. 4a	. 8	**
	C	4. 1ab	3. 3a	. 8	**
Significance between gins [2]		**	NS		
Alkali-centrifuge value	SG	182. 7a	189. 7a	−7. 0	NS
	FB	176. 0a	195. 3a	−19. 3	*
	C	177. 3a	191. 3a	−14. 0	NS
Significance between gins [2]		NS	NS		
Fiber neps number/100 sq. in	SG	21a	22a	−1	NS
	FB	19a	14 b	5	NS
	C	20a	13 b	7	NS
Significance between gins [2]		NS	***		
Pressley strength, ⅛-in. gage grams/tex	SG	32. 0a	33. 4a	−1. 4	NS
	FB	32. 0a	33. 1a	−1. 1	NS
	C	32. 0a	33. 0a	−1. 0	NS
Significance between gins [2]		NS	NS		
Array, upper quartile length in	SG	1. 35a	1. 32 b	. 03	**
	FB	1. 36a	1. 34a	. 02	*
	C	1. 36a	1. 33ab	. 03	**
Significance between gins [2]		NS	*		

See footnotes at end of table.

TABLE 3.—*Performance of 80-saw (SG), flight-bar roller (FB), and conventional roller (C) gins on first machine-picked and second machine-picked Pima S-2 cotton*—Continued

Property measured	Type of gin	Harvests [1]		Difference based on 1st-picked cotton	Significance between harvests [2]
		1st machine picked	2d machine picked		
Array, mean length in.	SG	1.10 b	1.08 b	0.02	NS
	FB	1.15a	1.11a	.04	**
	C	1.11 b	1.10ab	.01	NS
Significance between gins [2]		**	*		
Array, fibers 1 in. and longer pct.	SG	73.2 b	66.6 b	6.6	***
	FB	76.0a	71.4a	4.6	**
	C	75.7a	69.7ab	6.0	***
Significance between gins [2]		*	***		
Array, fibers ½ in. and shorter pct.	SG	5.3a	6.9a	−1.6	NS
	FB	4.8a	6.3a	−1.5	NS
	C	5.4a	6.2a	−.8	NS
Significance between gins [2]		NS	NS		
Fibrograph, upper half mean length in.	SG	1.26 b	1.22 b	.04	**
	FB	1.28a	1.24a	.04	**
	C	1.26 b	1.23ab	.03	*
Significance between gins [2]		*	*		
Fibrograph, mean length in.	SG	1.01 b	.97 b	.04	NS
	FB	1.06a	1.00a	.06	*
	C	1.03ab	.99ab	.04	NS
Significance between gins [2]		***	**		
Color, reflectance Rd.	SG	70.7a	72.8a	−2.1	*
	FB	70.5a	72.1a	−1.6	NS
	C	70.4a	72.9a	−2.5	*
Significance between gins [2]		NS	NS		
Color, yellowness plus b.	SG	11.4a	10.8a	.6	NS
	FB	11.1a	10.7a	.4	NS
	C	11.2a	10.8a	.4	NS
Significance between gins [2]		NS	NS		
Nonlint content-Shirley analyzer pct.	SG	2.57a	2.98ab	−.41	NS
	FB	2.42a	2.10 b	.32	NS
	C	2.81a	3.48a	−.67	NS
Significance between gins [2]		NS	**		
Lint moisture pct.	SG	4.69a	5.30a	−.61	NS
	FB	4.24 b	4.66 b	−.42	NS
	C	4.65ab	5.04ab	−.39	NS
Significance between gins [2]		**	**		
Gross, calculated bale weight lb.	SG	502a	507ab	−5	NS
	FB	498a	499 b	−1	NS
	C	503a	509a	−6	NS
Significance between gins [2]		NS	**		
Composite grade index.	SG	2.5a	2.5a	------------	NS
	FB	2.8a	2.2a	.6	NS
	C	2.7a	2.1a	.6	NS
Significance between gins [2]		NS	NS		
Staple length 32ds in.	SG	43.3 b	43.3 b	0	NS
	FB	44.7a	45.8a	−1.1	**
	C	44.7a	46.0a	−1.3	**
Significance between gins [2]		***	***		

See footnotes at end of table.

TABLE 3.—*Performance of 80-saw (SG), flight-bar roller (FB), and conventional roller (C) gins on first machine-picked and second machine-picked Pima S-2 cotton*—Continued

Property measured	Type of gin	Harvests [1]		Difference based on 1st-picked cotton	Significance between harvests [2]
		1st machine picked	2d machine picked		
Price per pound .... dol..	SG	0.5185 b	0.5135 b	0.0050	NS
	FB	.5401a	.5499a	—.0098	NS
	C	.5392a	.5503a	—.0111	NS
Significance between gins [2]		**	***		
Bale value .... dol..	SG	249.68 b	250.03 b	—.35	NS
	FB	258.45ab	263.41a	—4.96	NS
	C	260.21a	268.70a	—8.49	*
Significance between gins [2]		**	***		
Opening and picking waste .... pct..	SG	.78a	.88ab	—.10	NS
	FB	.82a	.56 b	.26	NS
	C	.98a	1.09a	—.11	NS
Significance between gins [2]		NS	**		
Card waste .... pct..	SG	3.61 b	3.57 b	.04	NS
	FB	3.64 b	3.88ab	—.24	NS
	C	3.87a	4.26a	—.39	**
Significance between gins [2]		*	***		
Total picker and card waste .... pct..	SG	4.40a	4.11 b	.29	NS
	FB	4.59a	4.94a	—.35	*
	C	4.62a	5.10a	—.48	**
Significance between gins [2]		NS	***		
Comber noils .... pct..	SG	15.0a	16.1a	—1.1	NS
	FB	14.8a	14.6 b	.2	NS
	C	15.0a	15.1 b	—.1	NS
Significance between gins [2]		NS	**		
Yarn strength .... break factor..	SG	2646 b	2838a	—192	NS
	FB	2715a	2887a	—172	NS
	C	2695ab	2850a	—155	NS
Significance between gins [2]		*	NS		
Card web .... neps/100 sq. in..	SG	11a	20a	—9	***
	FB	7 b	11 b	—4	**
	C	7 b	12 b	—5	**
Significance between gins [2]		***	***		
Total imperfections .... number/1,000 yd..	SG	802a	1478a	—676	NS
	FB	564a	799 b	—235	NS
	C	534a	736 b	—202	NS
Significance between gins [2]		NS	**		
Corrected ends down .... number/1,000 spindle hr..	SG	53a	98a	—45	NS
	FB	41a	54 b	—13	NS
	C	52a	64ab	—12	NS
Significance between gins [2]		NS	*		
Yarn appearance .... index..	SG	100a	93a	7	NS
	FB	107a	93a	14	**
	C	103a	97a	6	NS
Significance between gins [2]		NS	NS		

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[1] Values followed by the same letter do not differ significantly, and those followed by unlike letters differ significantly at the probability level shown by asterisks, according to Duncan's Multiple Range test.

[2] The probability level, or confidence in repeatability of results, is indicated by asterisks as follows: * * * at the 99-percent level; * * at the 95-percent level; and * at the 90-percent level. NS means not significant.

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